

Distribution, regeneration and succession of *Fagus*¹

Wu Gang(吴 刚)

Research Center for Eco-Environmental Sciences, the Chinese Academy of Sciences, Beijing 100080, P. R. China

Li Junqing(李俊清)

Beijing Forestry University, Beijing 100083, P. R. China

Abstract The distribution, regeneration and succession of *Fagus* in China were systematically analyzed in comparison with those in Europe and in northern America. The results showed that it was very likely that China was the distribution center of *Fagus*, which originated in eastern Asia, migrated into northern America and then into Europe. Distribution of *Fagus* in China is relatively independent with seven species. The main reason for wide distribution of *Fagus* in Europe, but unitary species, is possibly the influence of the climate in Quaternary Period, and also related with influence of the ocean climate.

Key words: *Fagus*, distribution, regeneration, succession.

History and distribution

Fagus is a very popular genus in the Northern Hemisphere. To study the *Fagus*' evolution history is important for revealing effects of world climate change on the plant, and geological and biological connection or divergence in the Eurasia. In the world, there are 14 species distributed throughout the temperate zone in the Northern Hemisphere, and they are the climatic climax plant in Europe and North America; however, it is only distributed discontinuously in hilly subtropical area in China. The fossil of *Fagus* has been found in Heilongjiang (Li 1993), Jilin (Hong 1993), and North of China. It suggests that *Fagus* had occurred in this area and had disappeared due to the geographical and historical evolution. There are 7 species in China, including *F. engleriana*, *F. longipetiolata*, *F. tientaiensis*, *F. hayatae*, *F. pashanica*, *F. lucida*, and *F. Chienii* (Hong 1993). It seems that China is the center of *Fagus*' origin and distribution. Yet the fact is not like that considering the distribution area and superiority (Muhs, 1993). In the Tertiary Period, *Fagus* originated from an unclear branch (Hong 1993). Its origin place was possibly the south of Yunnan Province and Eastern Asia, and then spread to the North of China and all over the world (Peters 1992; Wu 1980). Muhs and Venart consider that *F. sylvatica* first appeared in the Miocene epoch in the Tertiary Period. It is similar to *F. orientalis* in Near East very much (Muhs 1993; Vanart 1981). *F. sylvatica* is not the *Fagus*'s original species, but is differentiated and developed from *F. orientalis* which links up the Eurasia (Vanart 1981) and is mainly distributed in the temperate zone of Near East, from Roam, Nigeria, Greece, and Turkey to Iran and the southwest Russia. Nelson's research

has proved that *F. orientalis* can crossbreeding with *F. sylvatica*, but *F. sylvatica* cannot do so with *F. Grandifolia* (Nielsen 1954). It proves that the relationship between *F. sylvatica* and *F. grandifolia* is relatively far. Then, how about the relationship between *F. sylvatica* and other species is in Asia and China? According to the geographical location, *F. sylvatica* might be close to species in the South Asia. However, since the research hasn't begun, no conclusion can be made. But Hutley's research on pollen and world climate change has proved that *F. sylvatica* first appeared in 6 000a B.P in Europe (Hutley 1993), over 3 000a late comparing with Near East and Southwest Asia (Roberts 1993), and over 5,500a late comparing with China and Southeast Asia. *F. sylvatica* probably originates from East Asia and China, and spreads to Europe through Near East and Southwest Asia.

Fagus is distributed in South and Middle Plane (Henan Province) in China, and is mainly distributed in subtropical hilly area. The range of longitude is 10 degrees; latitude is about 18.5 degrees. The distribution altitude is from 700 to 2 600 m. *F. longipetiolata* is distributed in the Xichou County, Yunnan Province on the Tropic of Cancer, the southern limit of the genus distribution, with altitude from 1 500 to 1 850 m, where is warm and rainy and with typical subtropical characteristics. *F. engleriana* is distributed in the north slope of Funiu Mountain in Henan Province, the northern limit of the genus distribution, with an altitude of 1 200 m, where is moist and semi-moist monsoon. These two species are also distributed in the further directions of west and east of *F. longipetiolata* is distributed to Yongjia County in Zhejiang Province. The distribution of *F. engleriana* is in Erlong Mountain

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in Sichuan Province, with the altitudes from 1 000 to 2 500 m and moist monsoon or hilly subtropical monsoon climate. It is not a coincident that there are *F. engleriana*, *F. longipetiolata*, *F. pashanica* and *F. lucida* distributed in Sichuan and Zhejiang provinces (Fang 1993; Yang 1992) the most east and the most west distribution areas. From the comparison among several species in China, the distribution altitude of *F. lucida* is the highest, *F. engleriana* and *F. longipetiolata* is lower, and *F. pashanica* is the lowest. *Fagus* often grows on moist sites in the north facing slopes, where the precipitation is above 1 000 mm. *Fagus* is widely distributed in Europe. The distribution range is about 25° E and 35° N (Qi 1990; Wang 1993; Wu 1987; Zhang 1990; Fang 1991; Lin 1986; Xu 1990). The distribution limit to west is far to north and west of Spain. It is distributed from 200 m to 2 000 m, mainly from 1 500 m to 2 000 m (Timbal 1991), which is possibly related with soil conditions. East to Scandinavia east Poland, north to Sweden, south to Italy, *F. sylvatica* is distributed in middle part of plateau and wet mountains, because of the control of Atlantic climate (Timbal 1991). However, in the Mediterranean climate, *F. sylvatica* is replaced by *Quercus ilex* in lowland, only located in higher elevations on mountains, and replaced by conifers in other arid and plain regions (Thiebaut 1992; Kunfang, 1995; Hosking 1992).

Regeneration and succession

Through the studies on 4 species in age of 100,150a, Li Junqing and Wu Gang found that the young *Fagus* forest can be divided into 3 strata under sufficient light condition. Their average heights were 181.4, 94.5 and 36.3 cm. They can be divided into two strata under insufficient light condition by average heights of 85.3 cm and 45.2 cm. It is only one stratum as average height of 31.4 cm while almost no light. So the young *Fagus* regeneration number is small and growing rate is slow. The regeneration of the young *Fagus* depends upon the aging and death of arrow-bamboo and over story.

Conclusion and discussion

Fagus is very important material for studying geographical variation of species and geological evolution. It originated from East Asia, and then spread to the Europe and the North America; It originated from the America or the other place, and then spread to Europe. The *Fagus* in China was relatively independent. The main reason for wide distribution of *Fagus* in Europe, but unitary specie, is possibly the influence of the climate in Quaternary Period, and also related with influence of the ocean climate.

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